Slide 1

The Importance of Standardized Positioning:

The Basics of Mammography
That You Were Never Taught

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Slide 2

Source: U.S. Food & Drug Administration

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US Food and Drug Administration

- "In a 2002 study, the '[s]ensitivity [of mammography] dropped from 84.4% among cases with passing positioning to 66.3% among cases with failed positioning'."
- "Poor positioning has been found to be the cause of most clinical image deficiencies and most failures of accreditation." (92%)

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Decreased Sensitivity

- 84.4% with proper positioning
- 66.3% with failed positioning

= 18.1% decreased sensitivity

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Quality Standards – Why?

ALL industries have established *standardized* methods in the performance of tasks to:
- Establish and maintain quality
- Increase consumer satisfaction
- Increase profit
- Reduce possibility of litigation
- Reduce errors

How do we reduce medical errors?
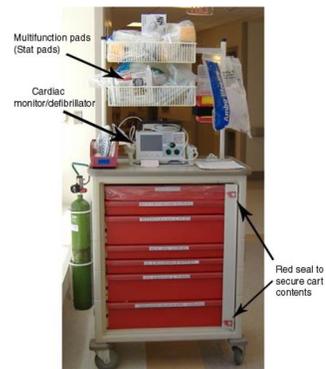
- Standardization
- Consistency
- Reproducibility

Multifunction pads (Stat pads)

Cardiac monitor/defibrillator

Red seal to secure cart contents

Standardized Technologist Training for General Radiology

Standardization

We *all*:
- Position the same way for every body part
- Position in the same sequence
- Set up the machine before we bring in the patient
- Position the whole patient, not just the body part

In General Radiology…

All training is competency based and a technologist's skills will be evaluated for *positioning techniques*, as well as *clinical image evaluation.*
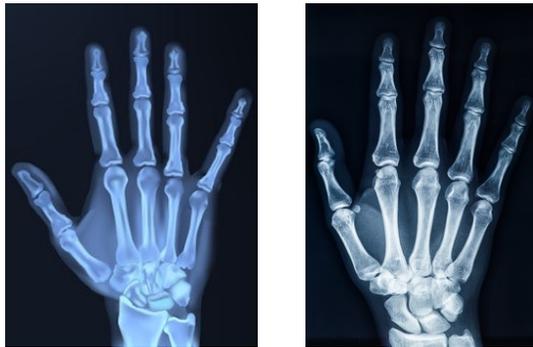
Consistency and Ergonomics

- **M**achine
- **P**atient
- **B**ody Part (Breast)

We position the **whole patient**,
not just the body part!

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14

All exams are done using the *same*
positioning technique, in the *same* sequence.

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Why???

- Consistency
- Reproducibility
- Efficiency
- Proficiency
- Use of proper body mechanics

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But in mammography…
We are "all over the map"

- LCC, LMLO, RMLO, RCC
- RCC, LCC, RMLO, LMLO
- RMLO, RCC, LMLO, LCC
- LCC, RCC, LMLO, RMLO
- RCC, RMLO, LMLO, LCC
- LCC, LMLO, RCC, RMLO
- LMLO, LCC, RCC, RMLO

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My Suggestion

- CCs first
- Then do the MLO on the side you just finished the CC
- Finish with the other MLO

Example: RCC, LCC, LMLO, RMLO

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So why is this true for all body parts in radiology EXCEPT in Mammography???
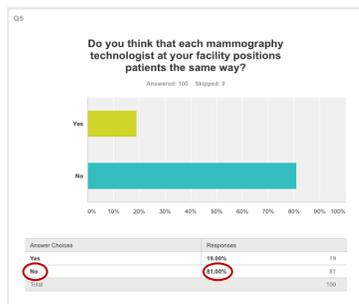
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In Mammography…

- Most technologists have not been taught a standardized method of positioning
- Most technologists have been taught various positioning methods by various technologists

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Most technologists *do not* practice a standardized method of positioning or position the same way.

No Standards for Mammography Positioning

There are standards for *WHAT* images should look like,
but not *HOW* you get to that point!

So the problem is…

No standardization or follow-through, which means:
- Less consistency and reproducibility
- More repeats and rejects
- More accreditation failures
- Increased radiation exposure
- MISSED BREAST CANCERS

How can we make things better?

Consistency and Reproducibility

Mammography Positioning Techniques

Should be:
- Consistent
- Reproducible
- Efficient
- Proficient
- Based on sound ergonomic principles

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Common Work-Related Injuries

- Wrists
- Shoulders
- Back
- Knees
- Hips

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YES!!!   NO!!!

27

YES!!!   NO!!!

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YES!!! NO!!!

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Slide 30
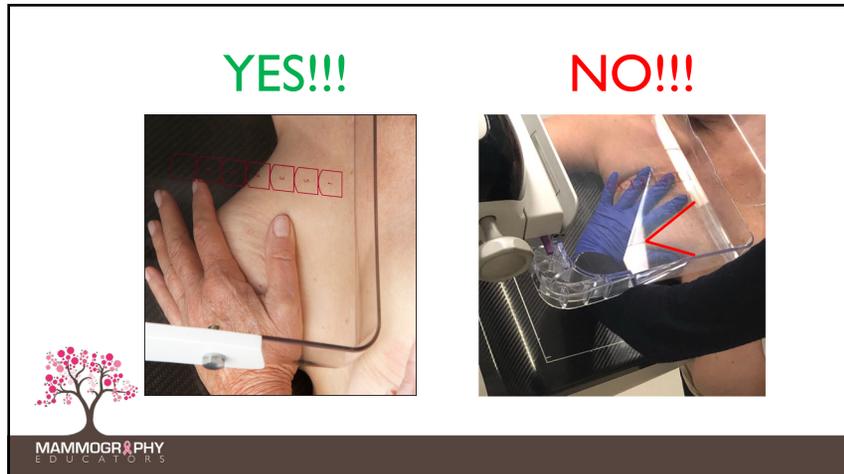
Do Standardized Positioning Techniques for Mammography Work?

- Scientific studies prove that standardized positioning techniques improve quality
  - Visualization of more posterior and lateral breast tissue, IMF and pectoralis muscle on the CC
- Unpublished data showed that standardized positioning techniques decrease repeats, rejects and technical callbacks by up to 50%!

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Mammography Positioning Standards in the Digital Era: Is the Status Quo Acceptable?

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Kelly L. Overman[2]
Jason B. Gatewood[1]
Jacqueline D. Hill[1]
Louise C. Miller[3]
Marc F. Inciardi[1]

OBJECTIVE. The objective of our study was to evaluate positioning of full-field digital mammography (FFDM) and digital breast tomosynthesis (DBT) compared with film-screen (FS) mammography positioning standards.
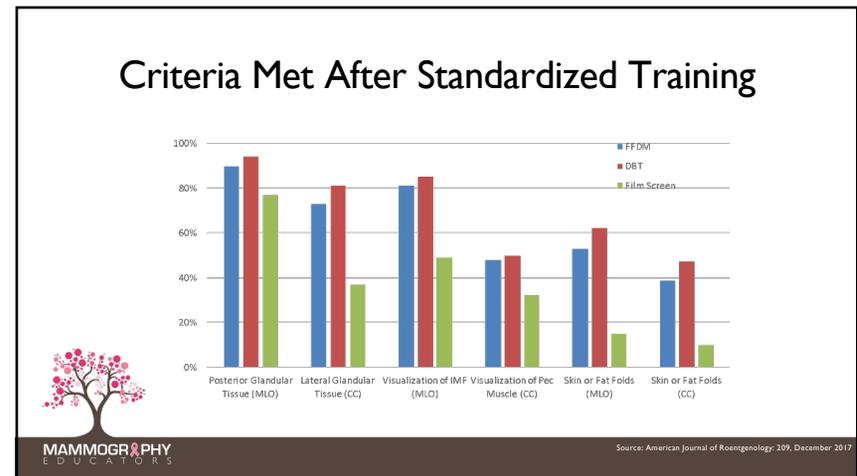
MATERIALS AND METHODS. A retrospective study was conducted of consecutive patients who underwent screening FFDM in 2010–2012 and DBT in 2012–2013 at an academic institution. Examinations were performed by five experienced technologists who underwent updated standardized positioning training. Positioning criteria were assessed by consensus reads among three breast radiologists and compared with FS mammography data from a 1993 study by Bassett and colleagues.

RESULTS. One hundred seventy patients (n = 340 examinations) were analyzed, showing significant differences between FFDM and DBT examinations (p < 0.05) for medial or inferior skin folds (FFDM vs DBT: craniocaudal [CC] view, 35% [n = 56] vs 23% [n = 77]; mediolateral oblique [MLO] view, 35% [n = 118] vs 45% [n = 154]), inclusion of lateral glandular tissue on CC view (FFDM vs DBT, 73% [n = 247] vs 81% [n = 274]), and concave pectoralis muscle shape (FFDM vs DBT, 36% [n = 121] vs 28% [n = 95]). In comparison with Bassett et al. data, all positioning criteria for both FFDM and DBT examinations were significantly different (p < 0.05). The largest differences were found in visualization of the pectoralis muscle on CC views and the inframammary fold on MLO views, inclusion of posterior or lateral glandular tissue, and inclusion of skin folds, with DBT and FFDM more frequently exhibiting all criteria than originally reported Bassett et al. findings.

CONCLUSION. DBT and FFDM mammograms more frequently include posterior or lateral tissue, the inframammary fold on MLO views, the pectoralis muscle on CC views, and skin folds than FS mammograms. Inclusion of more breast tissue with newer technologies suggests traditional positioning standards, in conjunction with updated standardized positioning training, are still applicable at the expense of including more skin folds.

Source: American Journal of Roentgenology: 209, December 2017

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Criteria Met After Standardized Training

Legend: FFDM, DBT, Film Screen

Categories: Posterior Glandular Tissue (MLO), Lateral Glandular Tissue (CC), Visualization of IMF (MLO), Visualization of Pec Muscle (CC), Skin or Fat Folds (MLO), Skin or Fat Folds (CC)

Source: American Journal of Roentgenology: 209, December 2017

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Reasonable Expectations for the CC

	Positioning Criteria	FFDM	DBT	Bassett
	Pec Muscle Visualized	48%	50%	32%
	No Motion	100%	98%	-
	Lateral Glandular Tissue Included	73%	81%	37%
CC View	Nipple in Profile	83%	85%	89%
	Skin or fat folds	39%	47%	10%
	Medial Location	16%	23%	-
	Lateral Location	29%	32%	-
	Visualization of Cleavage	41%	34%	-
	Requires More Than One View	5%	7%	-

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Reasonable Expectations for the MLO

	Positioning Criteria	FFDM	DBT	Bassett
	Visualization of Pec Muscle to PNL	86%	87%	81%
	Concave Pec	36%	28%	-
	Straight Pec	41%	46%	-
	Convex Pec	23%	26%	-
	Wide Margin at Top of Pec	95%	93%	-
	No Motion	98%	97%	99%
MLO View	Posterior Glandular Tissue Included	90%	94%	77%
	Nipple in Profile	89%	92%	88%
	Skin or fat folds	53%	62%	15%
	Upper Location	25%	27%	-
	Lower Location	35%	45%	-
	Visualization of Inframammary Fold	81%	85%	49%
	Requires More Than One View	13%	17%	-

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Reasonable Expectations

- Our patients have different and often challenging body habitus
- Their breast size, shape, mobility and tenderness are hugely variable

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Reasonable Expectations

Even the "perfect" patient, in terms of body habitus, breast mobility, etc. may provide a challenge that inhibits the technologist's ability to position and compress properly.

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But regardless of these variables, we CAN improve image quality by ***using standardized positioning techniques*** *and* developing a strong knowledge-based foundation that depends on the technologist's understanding of correlative anatomy.

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RCC: Steps 1-9 (Front)

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Quick Steps for the CC (Left)

___ 1. Elevate breast/IMF (until the PNL is perpendicular to the chest wall)

___ 2. Adjust IR height (so top edge is parallel with elevated IMF)

___ 3. Pull the breast onto the IR with both hands (left hand on top; right hand on bottom) and at the same time ask the patient to step forward into the machine (no leaning) and have them turn their face towards you

___ 4. Switch hands, so your right hand is on the top (palm down) and anchor the breast with the base of your right thumb.

___ 5. Lift the opposite/contralateral breast onto the IR with your left hand, palm facing up; then ask the patient to turn their right hip forward.

___ 6. Guide the patient's head forward and around the face shield, if possible

___ 7. Place your left elbow and forearm at the mid thoracic region (where their bra clasp would be) and gently push the patient forward

___ 8. Relax patient's left shoulder with your left hand, if possible

___ 9. Pull superior breast tissue forward by placing the base/edge of your right thumb on top of the breast against the chest wall, then apply compression while continuing to "push" the patient forward

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RMLO: Steps 1-10

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Quick Steps for the MLO (Left)

___ 1. Stand perpendicular to the patient with your sternum pressing against patient's right humerus

___ 2. Lift patient's left shoulder/arm up over the corner of the IR with your right hand in the patient's axilla. At the same time, your right hand should "meet" your left hand in the axilla and help to lift the patient's left shoulder up and over the IR

___ 3. IR is placed in back of axilla (just interior to latissimus dorsi)

___ 4. Patient's left hand should be resting on bar, with their elbow bent behind the IR

___ 5. Place your left hand on patient's left shoulder (if possible) to keep their shoulder relaxed and down

___ 6. Your right hand, with palm facing up, slides down lateral side of the breast to pull on lateral breast tissue and smooth out any skin folds

___ 7. Once your right hand is at the bottom of the breast, turn your hand over so that your hand is now palm down on the breast with the base of your thumb just anterior to the IMF

___ 8. Push the breast up and out with the base of your thumb, keeping continuous contact with the breast

___ 9. At the same, ask the patient to lift and flatten their other breast, as needed

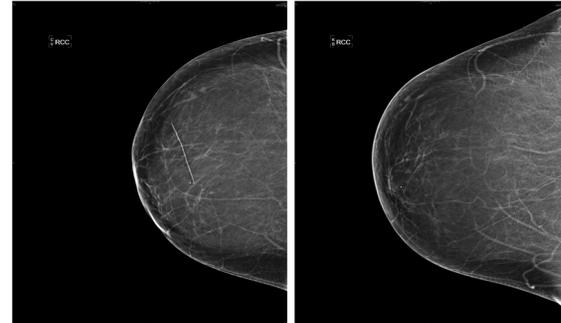___ 10. Continue to hold the breast in the up and out position until compression is complete

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Does it work??

BEFORE   STANDARDIZED POSITIONING   AFTER
13.6 cm   + 3.0 cm   16.6 cm

BEFORE   STANDARDIZED POSITIONING   AFTER
14.8 cm   + 2.0 cm   16.8 cm

BEFORE   STANDARDIZED POSITIONING   AFTER
13.9 cm   + 0.7 cm   14.6 cm

BEFORE **STANDARDIZED POSITIONING** **AFTER**
11.8 cm + 1.0 cm 12.8 cm

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Consistency and Reproducibility

Different techs – Different years – Miller Method

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Consistency and Reproducibility

Different techs – Different years – Miller Method
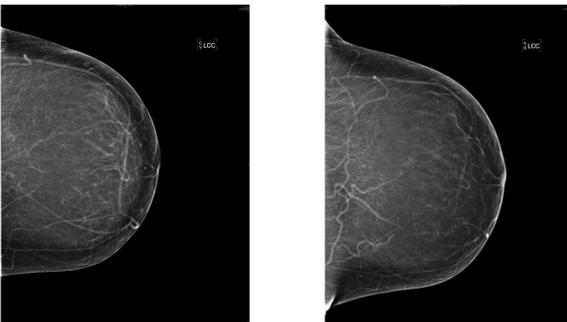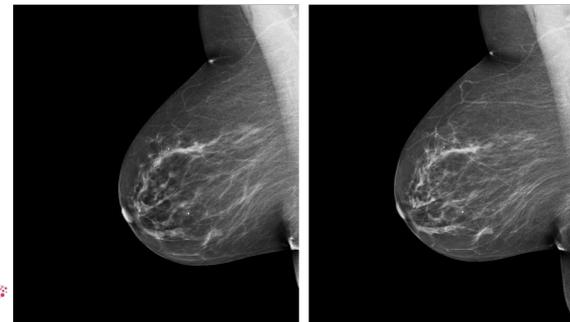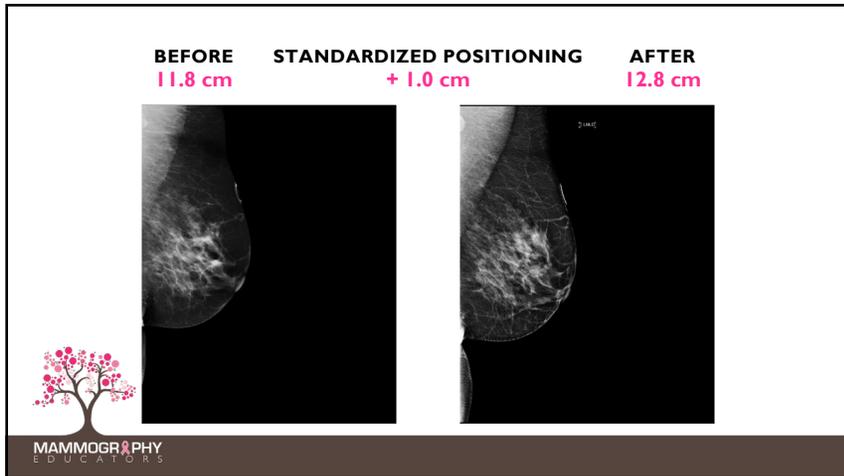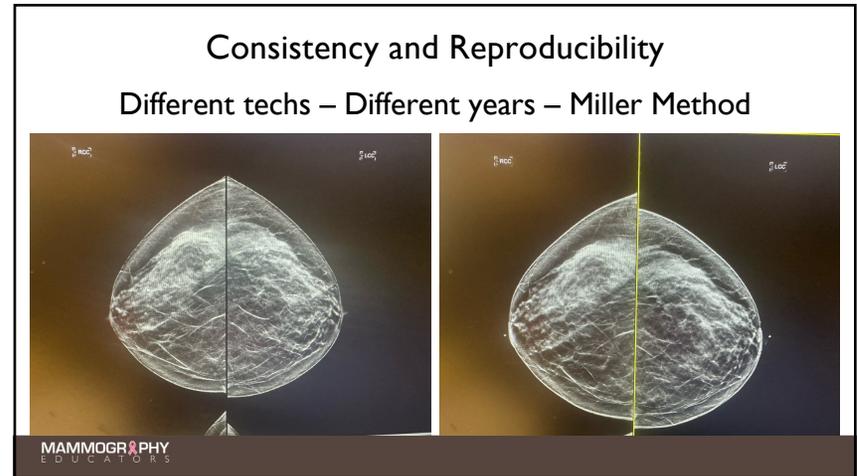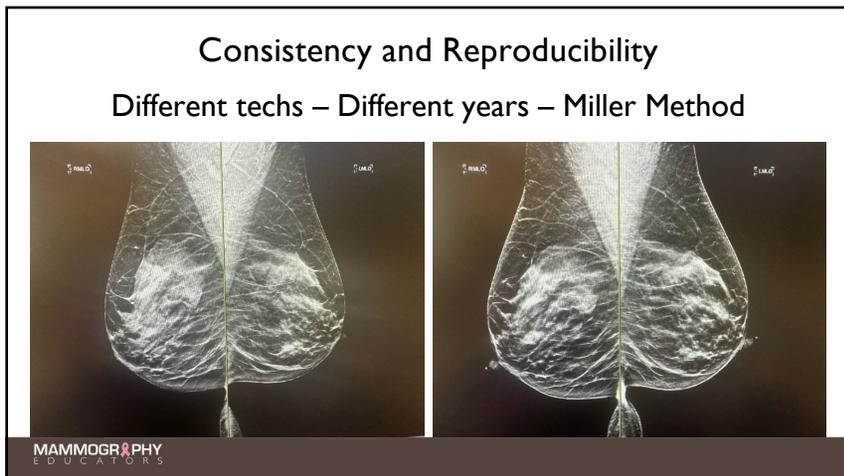
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It is ALL our responsibility to make sure that ALL patients receive the highest quality mammogram achievable.

Back To The Basics

Going back to the basics strengthens your foundation.

An Iota of Truth

Mammography should be taught according to scientific principle, NOT ANECDOTE!

Anecdote vs. Science

The tech who trained me said I should use 37 degrees on all MLOs.

Anecdote vs. **Science**

SCIENCE:

ANATOMY – PHYSIOLOGY – PHYSICS

You lucked out…

Except…

- Newton's Third Law: for every action there is reaction
- Law of gravity

Anatomy and Physiology

- As they relate to mammography positioning, using general radiology principles…

Goals for **General Radiology** Positioning

- Bring the body part back to its true anatomical position OR the position that will best visualize the body part
- Use palpable and visible anatomical landmarks for positioning and clinical image evaluation
- Use consistent and reproducible methods

Goals for **Mammography** Positioning

Bring the breast back to its natural anatomical position (*with the nipple perpendicular to the chest wall as possible*) on both screening views to maximize visualization of breast tissue and to avoid superimposition of structures.

Anatomy of the Breast
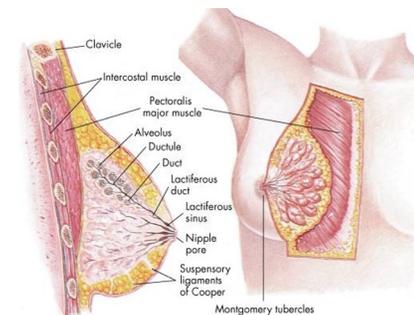
Normal or natural position of the breast is when the nipple is perpendicular to the chest wall.

65

When positioning for mammography we need to bring the breast back to its 'normal' position.

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In order to accomplish this and include the maximum amount of breast tissue, we must consider the anatomical landmarks that will be used for positioning and clinical image analysis.

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Perimeter

Pectoralis muscle

PNL
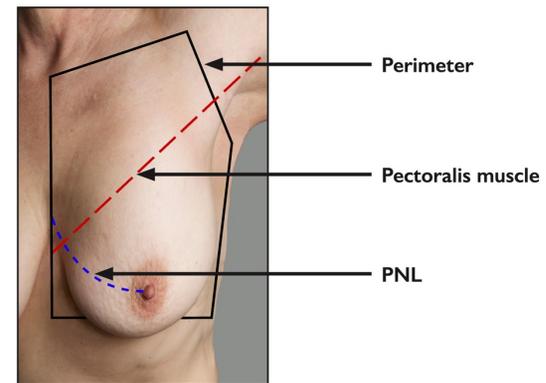
68

Perimeter of the Breast

69

Perimeter Used for Positioning and Clinical Image Analysis
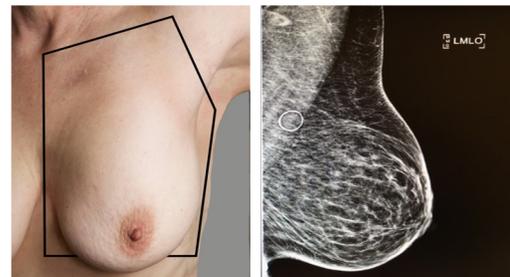
70

Pectoralis Used for Positioning and Clinical Image Analysis
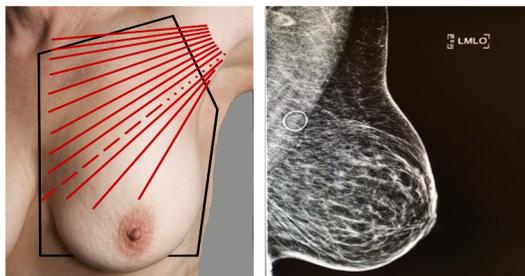
71

PNL Used for Positioning

Elevate the breast so that the PNL is as close as possible to perpendicular to the chest wall.
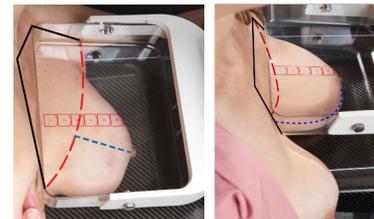
72

PNL Used for Clinical Image Analysis

PNL measurement of CC should be within
1cm of the PNL measurement on the MLO.

A) MLO   B) CC without Pec Muscle   C) CC with Pec Muscle
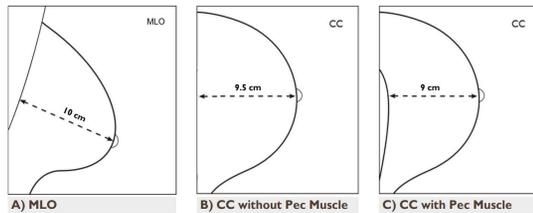
The MLO

- Inclusion of all breast tissue within perimeter
- Pectoral muscle fully visualized
- Tissue well separated
- Tissue visualized back to the retromammary fat space
- IMF
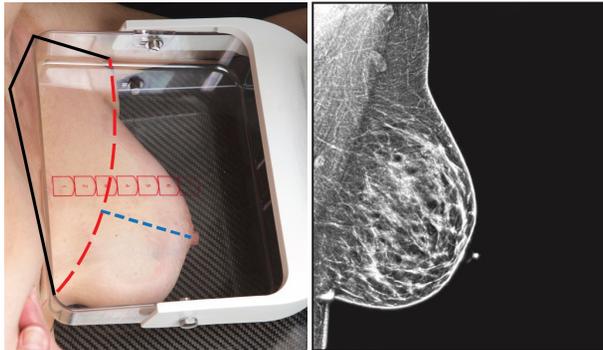
The MLO

Visualization of the pectoral muscle:

- The pectoralis muscle is not really part of the breast
- However, it serves as an important anatomical landmark for positioning and image evaluation

The absence or presence of these characteristics will tell you exactly what you did right or wrong when positioning and therefore, whether you included or excluded breast tissue!

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Remember

There are only two margins for error:

1) The way the **machine** is set up (i.e., height, angle, compression paddle size, etc.)

2) The way the **patient** is "set up": both feet, hips, and shoulders facing forward

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The MLO

- **Width**: wide margin at the top
- **Length**: down to the level of the PNL
- **Shape**: convex/straight

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The MLO

WIDTH of the Muscle

There should be a wide margin of the pectoralis muscle at the top of the image (in the axilla).
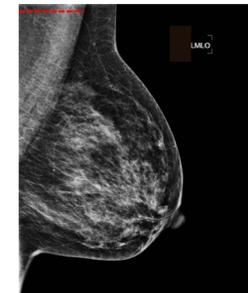
80

The MLO

EQUIPMENT: Width of the muscle is related to the placement of the IR in the axilla.

The back corner of the IR should be placed just anterior to the latissimus dorsi.

The MLO

PATIENT: Width of the muscle is related to the position of the patient.

The patient must be turned into the machine with both feet, hips and shoulders as far forward as possible. The patient's shoulder should be down and relaxed and if possible, held in position by the technologist.
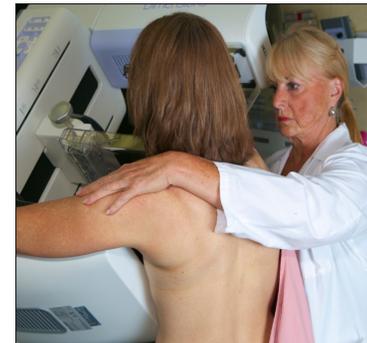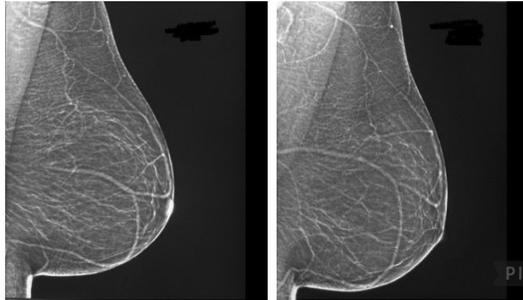
Width of the Muscle

The MLO

LENGTH of the Muscle

Should be visualized down to the level of the PNL.
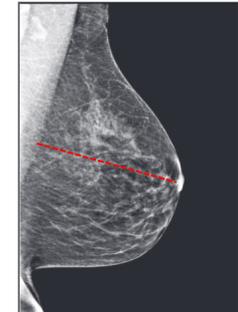
The MLO

EQUIPMENT: Angle for the MLO

- Angle to the free margin of the pectoralis muscle
- Keep angulation consistent
- Steeper angle for patients with longer thoraxes and small breasts
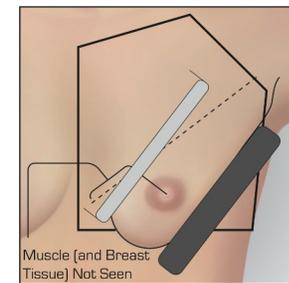- Lesser angles for shorter thoraxes and larger breasts

Proper degree of angulation

Angle too steep

Pectoralis Muscle Seen on Mammogram

PNL

Muscle [and Breast Tissue] Not Seen
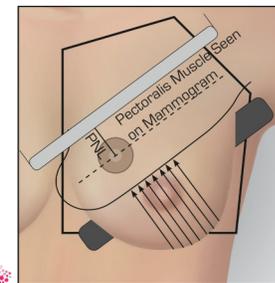
Recommended Angulation for the MLO

• Depends on body habitus
• Maintain consistency from year to year*

*An MLO angled at 56-degrees one year will look markedly different than an MLO angled at 42-degrees the next year.

Keep Angles Consistent

Use 5-degree increments – no more 43, 48, 52 degrees

• 40 degrees for shorter, heavier patients with large breasts
• 45 degrees for average patients
• 50 degrees for tall, thinner patients with smaller breasts
• 35 degrees for patients who have undergone reduction

The MLO

PATIENT: Length of the muscle is related to the position of the patient.

The patient must be turned into the machine with both feet, hips and shoulders as far forward as possible, as not to impede the progress of the compression paddle.
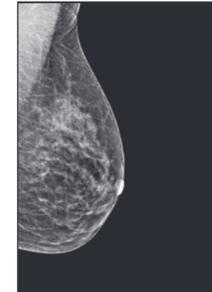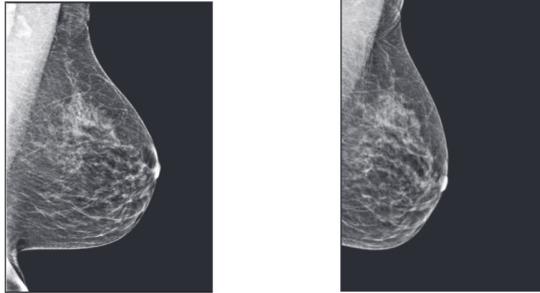
Proper degree of angulation   Angle too steep
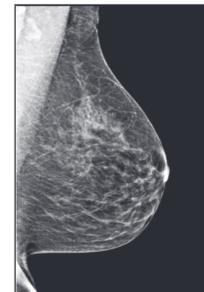
OR…
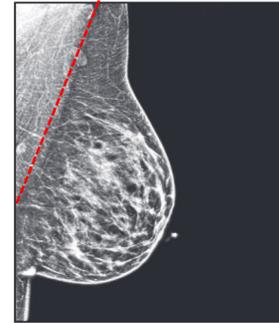### The patient is not facing the machine properly.

The MLO

SHAPE of the Muscle

The muscle should be convex or straight.

The MLO

EQUIPMENT: The shape and opacity of the muscle is related to the height of the IR.

The top of the IR should be positioned at the height of the sternoclavicular joint or halfway between the top of the shoulder and the axillary crease.
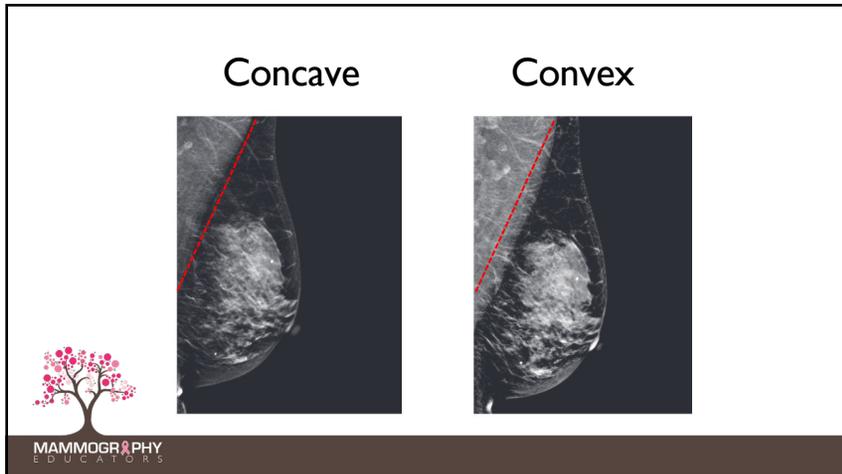
The MLO

PATIENT: The shape and opacity of the muscle is related to the relaxation of the pectoralis muscle.
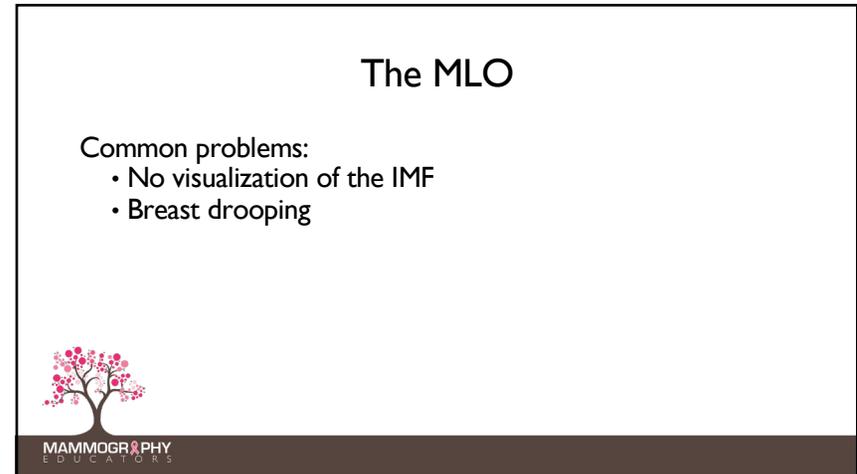
Patient's shoulder, arm and hand must be relaxed with the elbow bent and relaxed behind the IR.
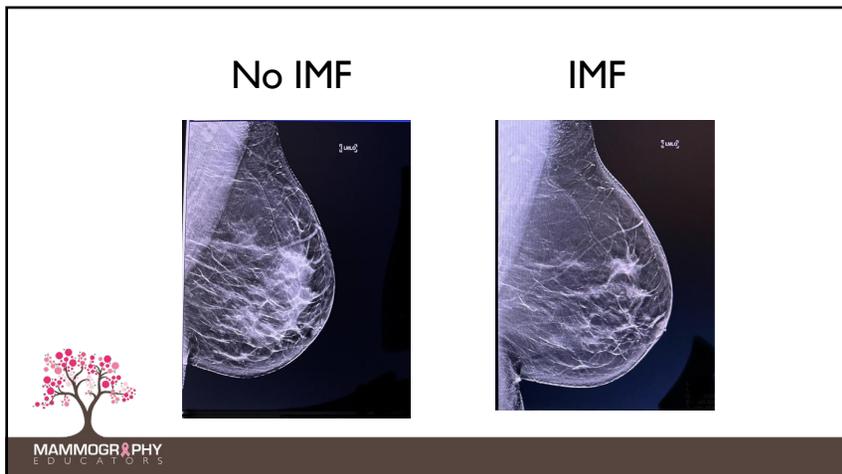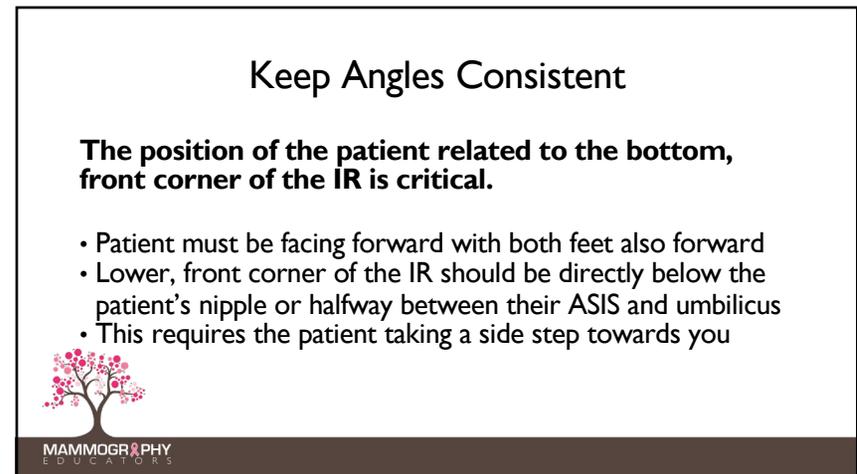
Concave   Convex

The MLO

Common problems:
- No visualization of the IMF
- Breast drooping

No IMF   IMF

Keep Angles Consistent

The position of the patient related to the bottom, front corner of the IR is critical.

- Patient must be facing forward with both feet also forward
- Lower, front corner of the IR should be directly below the patient's nipple or halfway between their ASIS and umbilicus
- This requires the patient taking a side step towards you

Improper
Edge of IR in front of IMF

Proper
Edge of IR behind IMF

Top edge of IR indicated by vertical dotted line.
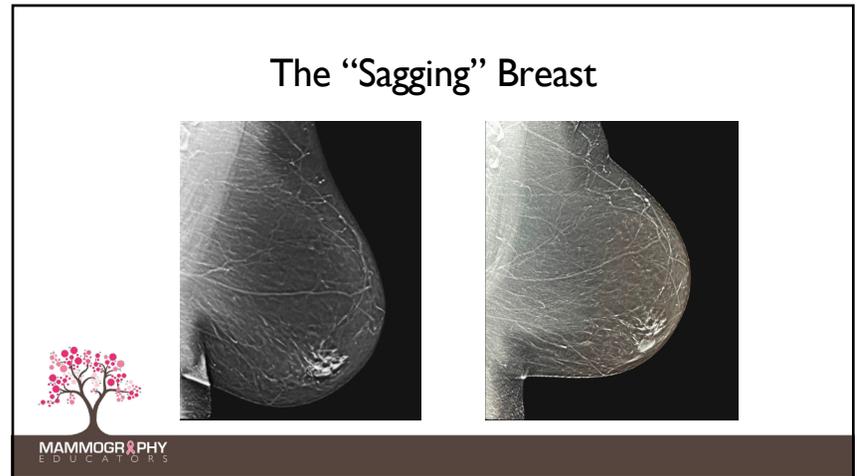

RMLO

RMLO

The "Sagging" Breast

The "Sagging" Breast

101

102

103

104

The "Sagging" Breast

LMLO   LMLO
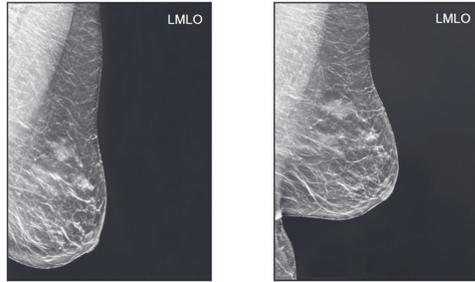
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The "Sagging" Breast
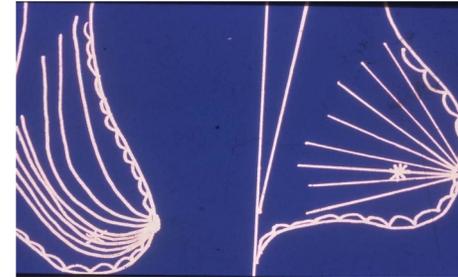
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Stages of Breast Cancer Development

Myoepithelium   Cancer cells

Normal duct | Ductal hyperplasia | ADH | DCIS | Invasive ductal carcinoma
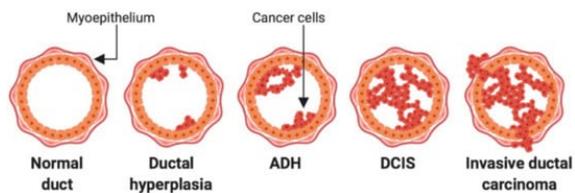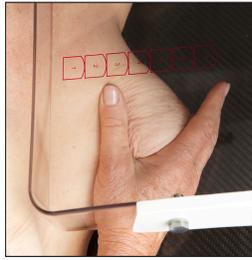
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Position of the Breast

- Breast must be held in the "up and out" position to bring the breast back to its "normal" position (nipple perpendicular to the chest wall)
- Maintained by adequate compression
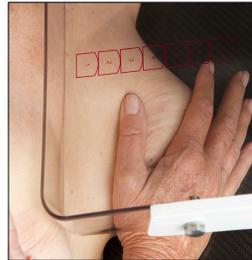- Don't let go until compression is complete

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Solution for the "Sagging" Breast

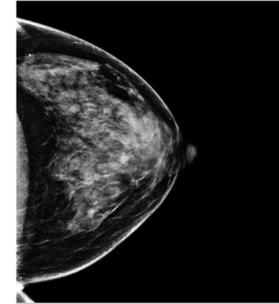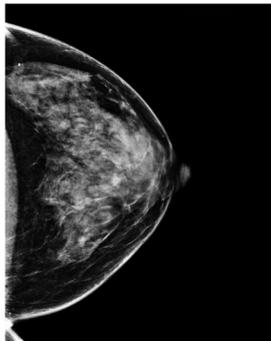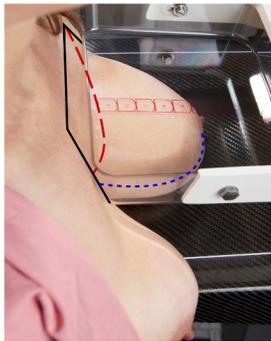Hold the breast in up and out position.

Compress.

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The CC

- Include maximum amount of breast tissue in the axial/transverse plan
- Visualization of medial breast tissue
- Visualization of pectoralis muscle on approximately 50% of all CCs
- PNL within 1cm of PNL on MLO

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The CC

- The CC is done to provide an "orthogonal" view from the MLO
- When added to the MLO, it increases breast cancer detection
- While the CC is not primarily done to visualize medial breast tissue (cleavage), it is a "by-product" of a good CC
- If you miss breast tissue on the MLO, it will be medial tissue, so it's important to try to include that on the CC view

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The CC

Is it the equipment or the patient?

Equipment:
- IR too high or too low
- Compression paddle size

Patient:
- Facing towards the machine with both feet, hips and shoulders forward

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Due to lack of anatomical landmarks, positioning techniques are extremely important!!
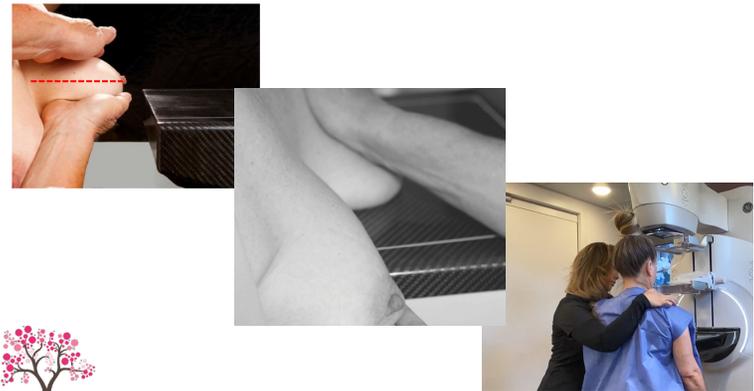

The CC

Common problems:
- Short CC (PNL measurement on CC is less than 1 cm of PNL measurement on the MLO)
- No pec muscle (remember the 50% rule!)
- No visualization of deep medial breast tissue (cleavage)

All of these are most often related to positioning technique vs. equipment and patient position.
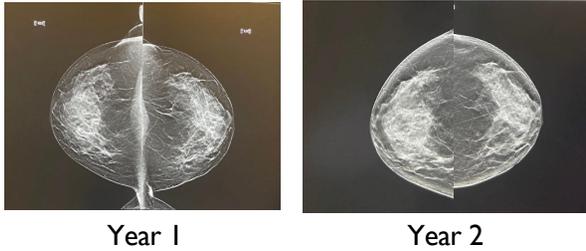(Although they are still important!)

Meet, Beat, **Repeat**

Year 1   Year 2

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Focus On…

- Consistency
- Reproducibility
- Efficiency
- Proficiency
- Ergonomic principles

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Mammography Saves Lives!

But it is up to you…….

Even the best radiologist, in the best breast center cannot diagnose a cancer that is not included on the image.

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References

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Thank You!

Services we offer, include:
- Onsite Positioning Training
- Assistance with Accreditation & Inspection
- Live Webinars and Conferences
- On-Demand Continuing Education

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